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ORIGINAL ARTICLE

Predictors of Health-related Quality-of-life Change after Total Hip Arthroplasty

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Abstract Various parameters have been considered as possible predictors of health-related quality-of-life outcomes after THA in patients with hip osteoarthritis. We hypothesized the preintervention health status is the main and more homogeneous predictor of changes of the different aspects of health-related quality-of-life outcomes, mental health status has an important influence on results, whereas other sociodemographic or clinical factors had only a punctual influence. All patients who fulfilled the selection criteria completed the Medical Outcomes Study SF-36 and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) before and 6 months after the intervention. Seven hundred eighty-eight patients completed the questionnaire before the intervention and 590 completed it (74.9%) at 6 months. The preintervention score in each SF-36 and WOMAC domain and the SF-36 mental health domain predicted changes after the intervention. Female gender, having comorbidities, contralateral hip osteoarthritis, or back pain predicted less improvement on some SF-36 domains. Older age, the presence of contralateral hip osteoarthritis, or back pain predicted less improvement on some of the WOMAC domains. Preintervention health status, measured by the WOMAC or SF-36, and mental health status uniformly predicted health-related quality-of-life changes, whereas some clinical parameters predicted some domains. SF-36 and WOMAC seem to be appropriate tools for predicting THA outcomes.
Level of Evidence: Level II, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

THA is a successful and effective surgical procedure in patients with serious hip disorders, especially in patients with osteoarthritis (OA) [12, 42]. The parameters used to measure the results of THA are diverse but should include the patient's opinion of the outcomes obtained. Patients' health-related quality of life (HRQoL) can be measured using several different validated questionnaires, including the generic SF-36 [43] questionnaire and the specific WOMAC [3].

Previous studies suggest the preintervention characteristics associated with outcomes after a THA are the HRQoL preintervention scores [15] and variables such as age [32], gender [24], obesity [20], social support

[13], number of comorbidities [4], preintervention mental health [4], contralateral OA [33], and unilateral or bilateral intervention [9]. However, there still is disagreement regarding which factors are most likely to predict benefit from surgical intervention.

We posed three hypotheses: (1) the preintervention health status is the main predictive variable of change after the intervention; (2) worse mental health status has a negative impact on the results; and (3) other patient preintervention characteristics have influence on some of the HRQoL outcomes of the WOMAC and SF-36 reported by patients with OA evaluated at 6 months and 2 years after THA.

Materials and Methods

We followed selected patients having a diagnosis of hip OA and undergoing THA in seven hospitals. Between March 1999 and March 2000, 1495 patients were placed on waiting lists to undergo THA. We excluded patients with a malignancy or other organic or psychiatric conditions that rendered them unable to participate in or complete the questionnaires; we also excluded patients with avascular necrosis, rheumatoid arthritis, revisions, and hip fractures. Therefore, 504 of the 1495 patients were excluded: 326 did not have a diagnosis of OA, 69 had severe organic or psychiatric diseases, and 109 did not undergo the surgical intervention owing to death, intervention at another hospital, or refusal to undergo the intervention during the year of the study. Of the 991 patients who fulfilled the selection criteria, 817 patients agreed to participate and completed the questionnaires sent to them before the intervention. We had access to complete medical records for 799 of them with a diagnosis of OA; of these, 788 completed the questionnaires before the intervention and 590 (74.9%) completed the questionnaires before and 6 months after the intervention. Because of economic restrictions, the followup of the patients at 2 years was performed in the three hospitals with a higher volume of patients. Of the patients from the three hospitals who were followed for 2 years, 469 responded to the questionnaires before surgery, 379 (80.8%) at 6 months, and 310 (81.8% from 6 months and 66% from preintervention) at 2 years. These are the samples included in this study. We found no differences in sociodemographic variables and main clinical characteristics, including pain or functional limitation, between responders and nonresponders (Table 1). No differences were found between the whole sample followed until 6 months and the subsample followed until 2 years in any of the variables and in the preintervention HRQoL scores. The ethics review boards of our respective institutions approved the study.

We collected data from the hospital medical records and directly from the patients. To retrieve data from the medical records, we developed data collection questionnaires that included sociodemographic data, the primary patient complaint, weight and height, time with symptoms before the intervention, time on the waiting list until the intervention was performed, and data regarding the intervention, including type of fixation mechanism. We also recorded comorbidities (as measured by the Charlson Comorbidity Index [8]). In this index, each of 22 comorbid conditions is given a score depending on the risk of dying associated with this condition and these scores then are summed to obtain a total score. The presence of previous hip problems, previous hip surgeries, OA in the contralateral hip, and low back pain also was recorded. All patients on the waiting list for THA received a letter informing them of the study and asking for their voluntary participation. They received the SF-36 [43] and WOMAC [3] questionnaires by mail along with additional questions regarding the presence of comorbidities, social support, and expectations before the intervention. A reminder letter was sent to patients who had not replied after 15 days. We then sent the questionnaires again and contacted patients by telephone who still had not replied after another 15 days. Six months after the intervention, patients received the same questionnaires. Patients who did not reply to these questionnaires were considered nonresponders. The followup for patients not responding was as described previously. Data regarding complications after the intervention or reinterventions also were recorded.

The SF-36 is a generic instrument for measuring the HRQoL [43]. The 36 items cover eight domains (physical function, role physical, bodily pain, general health, vitality, social function, role emotional, and mental health) and can be incorporated into two physical and mental summary scales. For the purpose of this study, only the first four domains more related to physical HRQoL aspects and the mental component summary scale (MCSS) were used as outcomes for this tool. The SF-36 scores range from 0 to 100, with a higher score indicating better health status. The SF-36 has been translated into Spanish and validated in Spanish populations [1].

The WOMAC is a disease-specific, self-administered questionnaire developed to study patients with hip or knee OA [3]. It has a multidimensional scale comprising 24 items grouped into three dimensions: pain (five items), stiffness (two items), and physical function (17 items). We used the categorical version. The data were standardized to a range of values from 0 to 100, in which 0 represents the best health status and 100 the worst health status. The original questionnaire is reliable, valid, and sensitive to the changes in the health status of patients with hip or knee OA [2, 10].

Table 1. Sociodemographic, clinical, and descriptive statistics of our sample

Variable	Total (n = 788)	Nonresponders (n = 198)	Responders (n = 590)	p Value
Gender				0.80
Women	381 (48.35%)	94 (47.47%)	287 (48.64%)	
Men	407 (51.65%)	104 (52.53%)	303 (51.36%)	
Age				0.86
> 70 years	387 (49.11%)	96 (48.48%)	291 (49.32%)	
≤ 70 years	401 (50.89%)	102 (51.52%)	299 (50.68%)	
Marital status				0.36
Married	540 (69.50%)	129 (65.82%)	411 (70.74%)	
Divorced	7 (0.90%)	3 (1.53%)	4 (0.69%)	
Widow	160 (20.59%)	42 (21.43%)	118 (20.31%)	
Single	70 (9.01%)	23 (11.22%)	48 (8.26%)	
Education				0.98
Primary	650 (84.57%)	165 (84.62%)	485 (84.64%)	
Secondary	96 (12.50%)	24 (12.31%)	72 (12.57%)	
Graduate	22 (2.86%)	6 (3.08%)	16 (2.79%)	
Body mass index (kg/m^2)				0.36
> 30	250 (33.57%)	58 (31.69%)	192 (33.57%)	
25–30	363 (48.08%)	84 (45.90%)	279 (48.78%)	
< 25	142 (18.81%)	41 (22.40%)	101 (17.66%)	
Contralateral hip OA	338 (42.89%)	97 (48.99%)	241 (40.85%)	0.05
Lower limb OA (knees or ankles)	138 (17.51%)	32 (16.16%)	106 (17.97%)	0.59
Previous hip disorders	68 (8.63%)	14 (7.07%)	54 (9.15%)	0.46
Back pain	402 (54.47%)	102 (53.40%)	300 (54.84%)	0.74
Charlson Comorbidity Index				0.11
> 2	22 (2.79%)	5 (2.53%)	17 (2.88%)	
1–2	303 (38.45%)	64 (32.32%)	239 (40.51%)	
0	463 (58.76%)	129 (65.15%)	334 (56.61%)	
Social support	696 (90.39%)	177 (90.31%)	519 (90.42%)	0.96
Age*	69.13 ± 8.91	68.51 ± 9.88	69.34 ± 8.54	0.29
Days before intervention*	156.19 ± 101.91	158.15 ± 130.39	155.62 ± 92.17	0.81
Days with pain*	45.39 ± 59.74	37.59 ± 40.84	48.05 ± 64.75	0.01

* Values expressed as mean ± standard deviation; OA = osteoarthritis.

The unit of study was the patient. In cases in which two interventions were performed for the same patient during the recruitment period, we selected the first one.

Descriptive statistics included frequency tables, means, and standard deviations. In the univariate analysis, the unadjusted effect of the predictors on HRQoL improvement was estimated for each SF-36 and WOMAC domain. The selected potential predictors included were age, gender, level of education, marital status, social support, body mass index, presence of previous hip disorders, OA in the contralateral hip, low back pain, comorbidities as measured by the Charlson Comorbidity Index, time with symptoms before the intervention, time from when the intervention was indicated until it was performed, expectations before the intervention of symptom relief, and the basal mental health status based on the score of the SF-36 mental health domain as a simple measure of anxiety or depression problems. In the univariate analysis, general linear models were performed for all predictive variables included in the study (Table 2). To more adequately interpret the β coefficients of the HRQoL domains, all were estimated as a 10-unit improvement. Therefore, for instance, the interpretation of the results of a coefficient of −37.7 in the role physical domain corresponds to a decrease of 37.7 units as preintervention domains increase 10 units. Interpretation of β coefficients in the case of the categorical variables, for instance, for women, for a value of −11.05 in SF-36 physical function means 11.05 points less than men (reference group) in the mean change in that domain, with the other patient characteristics being the same.

Variables statistically significant in the univariate analysis were included in multivariate analyses. In these

Table 2. Nonadjusted predictors of SF-36 and WOMAC domain changes 6 months after THA (n = 788)

Studied variables	WOMAC domains			Sf-36 domains				
	Pain	Stiffness	Functional limitation	Physical functioning	Role physical	Bodily pain	General health	MCSS
Age	0.50	0.51	0.38	0.30	0.25	0.76	0.43	0.90
Gender (female)	0.56	0.79	0.87	0.01	0.0002	0.004	0.08	0.54
Level of education	0.001	0.03	< 0.001	0.26	0.75	0.04	0.50	0.30
Marital status	0.15	0.01	0.24	0.18	0.22	0.02	0.53	0.24
Social support	0.19	0.46	0.41	0.13	0.008	0.25	0.99	0.79
Body mass index	0.15	0.50	0.13	0.01	0.49	0.91	0.41	0.94
Previous hip disorders	0.57	0.60	0.22	0.95	0.18	0.56	0.99	0.27
Contralateral hip OA	0.43	0.62	0.02	0.002	0.16	0.52	0.42	0.86
Lower limb OA (knees or ankles)	0.92	0.67	0.76	0.99	0.74	0.53	0.41	0.61
Back pain	0.16	0.09	0.46	0.46	0.52	0.04	0.24	0.27
Charlson Comorbidity Index	0.92	0.36	0.35	0.24	0.52	0.58	0.47	0.06
Days with pain before intervention	0.61	0.01	0.48	0.07	0.62	0.47	0.16	0.62
Days before intervention	0.10	0.52	0.06	0.25	0.003	0.41	0.57	0.62
Expectations on pain relief	0.62	0.46	0.90	0.44	0.89	0.28	0.12	0.84
SF-36 mental health domain	0.002	0.25	0.27	< 0.001	0.006	0.06	0.004	NA
Preintervention domain	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

MCSS = SF-36 mental component summary scale; OA = osteoarthritis; NA = not applicable.

analyses, general linear models were performed for each SF-36 and WOMAC domain using men younger than 70 years, without contralateral hip OA, comorbidities, or back pain as the reference because those were the statistically significant variables in the univariate analysis and those categories were expected to have higher gains. R^2 values, as a measure of variability explained by each model, were obtained for all the models. All statistical analyses were performed using SAS® for Windows® statistical software, 8.2 Release (SAS Institute, Inc, Cary, NC).

Results

Preintervention WOMAC and SF-36 health status were the main predictive variables of change after the intervention. Lower preintervention HRQoL values in each respective domain uniformly predicted higher improvement after the intervention in all SF-36 domains (Table 3). The multivariate analysis of the WOMAC domains (Table 4) showed the worse the preintervention status on the respective domains, the higher was the change after the intervention in the three WOMAC domains.

Mental health status influenced HRQoL outcomes. The better the preintervention mental health status as measured by the SF-36 mental health domain, the higher the gains, with the exception of general health (Table 3). The multivariate analysis of the WOMAC domains (Table 4) showed the better the preintervention mental health status, the higher the change in all domains.

Other different patient preintervention characteristics have influence on HRQoL outcomes. In the case of SF-36 outcomes, women had worse scores (less gain) in all the SF-36 domains than men with otherwise similar conditions. The presence of contralateral hip OA was associated with worse scores in the physical functioning domain; having comorbidities as measured by the Charlson Comorbidity Index was associated with worse scores in the domains of physical functioning, role physical, and MCSS. The previous presence of back pain was related to worse scores in mean changes of all SF-36 domains except in the physical functioning and role physical, whereas age or the presence of social support were not related to changes in any of the domains (Table 3). Being older predicted worse WOMAC scores in the pain domain; the presence of contralateral hip OA predicted lower score gains in the pain and functional limitation domains. None of the other variables had any relationship with the changes after the intervention in the three WOMAC domains after adjusting for all variables included in the multivariate analysis (Table 4). The relative predictive powers (R^2 values) were greater than 20% to 40% in SF-36 domains such as the physical functioning, bodily pain, and MCSS. In the case of the WOMAC, the obtained R^2 values were approximately 50% for pain and stiffness and greater than 30% in the functional limitation domain. The percentage of the variability explained by the preintervention score of each domain of the SF-36 was, in

Table 3. Adjusted predictors of SF-36 domain changes 6 months after THA*

Variable effects	Physical functioning		Role physical		Bodily pain		General health		MCSS	
	β_i	p value	β_i	p value	β_i	p value	β_i	p value	β_i	p value
Intercept	51.28	< 0.001	31.68	< 0.001	55.87	< 0.001	34.00	< 0.001	39.50	< 0.001
Preintervention domain	−8.64	< 0.001	−17.91	< 0.001	−7.77	< 0.001	−4.73	< 0.001	−6.58	< 0.001
Preintervention SF-36 mental health domain	0.45	0.01	1.15	0.002	0.55	0.01	0.17	0.20	NA	NA
Age (> 70 years)	−2.91	0.15	3.98	0.33	1.92	0.42	1.28	0.39	0.82	0.41
Gender (female)	−11.05	< 0.001	−15.58	< 0.001	−8.62	< 0.001	−3.58	0.02	−3.71	< 0.001
Contralateral hip OA (yes)	−8.84	< 0.001	−7.66	0.06	−3.35	0.17	−0.65	0.66	0.53	0.60
Charlson Comorbidity Index										
1–2	−5.34	0.01	−5.34	0.20	−3.91	0.11	−3.92	0.01	−1.59	0.12
> 2	−9.17	0.12	11.84	0.33	3.01	0.66	−1.56	0.71	−4.09	0.16
Back pain (yes)	−3.12	0.13	−4.42	0.29	−11.45	< 0.001	−3.42	0.02	−2.87	0.005
Model R^2	38.16%		21.48%		32.21%		22.01%		43.78%	

* Models obtained taking as reference men younger than 70 years without previous hip disorders, comorbidities, and back pain; β_i = estimated β coefficient; MCSS = SF-36 mental component summary scale; NA = not applicable; OA = osteoarthritis.

Table 4. Adjusted predictors of WOMAC domain changes 6 months after THA*

Variable effects	Pain		Stiffness		Functional limitation	
	β_i	p value	β_i	p value	β_i	p value
Intercept	14.31	< 0.001	20.01	< 0.001	22.27	0.003
Preintervention domain	−8.85	< 0.001	−8.98	< 0.001	−8.23	< 0.001
Preintervention SF-36 mental health domain	−0.32	0.01	−0.38	0.01	−0.44	0.002
Age (> 70 years)	−2.93	0.04	−0.61	0.72	−0.47	0.76
Gender (female)	2.01	0.16	3.11	0.08	2.82	0.08
Charlson Comorbidity Index						
1–2	1.76	0.22	1.53	0.39	2.40	0.13
> 2	0.33	0.93	−0.11	0.98	0.72	0.87
Contralateral hip OA (yes)	3.95	0.006	3.48	0.05	6.39	< 0.001
Back pain (yes)	2.28	0.11	0.68	0.70	2.36	0.13
Model R^2	48.97%		52.45%		35.50%	

* Models obtained taking as reference men younger than 70 years without previous hip disorders, comorbidities, and back pain; β_i = estimated β coefficient; OA = osteoarthritis.

general, greater than 70%, whereas in the case of the WOMAC domains, they predicted between 87% and 95%. When considering the previous predictive variables at 2 years (Table 5), level of education did not predict changes in the SF-36 domains, and gender and Charlson Comorbidity Index (> 2) predicted only MCSS. For the WOMAC, age was no longer predictive of changes, although back pain was. The R^2 almost had no change or even improved.

Discussion

Determining the influence of various preintervention clinical, sociodemographic, or health status parameters in the changes obtained by patients undergoing a THA is a key, valuable, and practical issue for clinicians, and also for patients. It can help clinicians in their medical decision-making process. Various publications have partially studied this issue. Our study, with a relatively large prospective cohort of patients, addressed the question of the influence of most of those parameters on THA results at 6 months after the intervention. Our hypotheses were that the preintervention health status is the main and more homogeneous predictor of changes of the different aspects of HRQoL outcomes measured by two well-known instruments (SF-36 and WOMAC), worse mental health status also consistently predicts poorer results, whereas other patient characteristics may have an influence on some of the measured outcomes.

Table 5. Adjusted predictors of SF-36 and WOMAC domain changes 2 years after THA*

Variable effects	WOMAC domains						SF-36 domains									
	Pain		Stiffness		Functional limitation		Physical functioning		Role physical		Bodily pain		General health		MCSS	
	β_i	p value	β_i	p value	β_i	p value	β_i	p value	β_i	p value	β_i	p value	β_i	p value	β_i	p value
Intercept	−12.35	< 0.001	−21.50	< 0.001	−19.73	0.004	39.53	< 0.001	27.42	0.01	56.06	< 0.001	26.10	< 0.001	40.84	< 0.001
Preintervention domain	8.68	< 0.001	9.87	< 0.001	8.37	< 0.001	−7.58	< 0.001	−22.60	< 0.001	−9.15	< 0.001	−4.33	< 0.001	−7.22	< 0.001
Preintervention SF-36 mental health domain	0.71	< 0.001	0.78	< 0.001	0.75	< 0.001	1.17	< 0.001	2.24	< 0.001	0.99	0.003	0.38	0.08	NA	NA
Age (> 70 years)	0.26	0.88	−1.27	0.57	−2.68	0.21	−9.82	0.001	−8.21	0.12	−1.80	0.59	−2.80	0.20	−1.92	0.13
Gender (female)	−0.29	0.87	−4.38	0.06	−0.76	0.73	−2.989	0.35	2.00	0.72	−4.37	0.21	−3.95	0.08	−3.05	0.02
Contralateral hip OA (yes)	−1.92	0.30	−1.82	0.42	−5.62	0.01	−9.16	0.003	−12.87	0.02	−5.12	0.14	−1.56	0.49	1.32	0.31
Charlson Comorbidity Index																
1–2	−1.76	0.33	−0.993	0.68	−1.33	0.54	−2.02	0.52	−1.85	0.73	−3.18	0.36	1.30	0.57	0.59	0.65
> 2	1.21	0.86	−1.71	0.84	−11.48	0.15	−14.29	0.20	−20.39	0.33	−33.94	0.01	−23.60	0.004	−11.26	0.04
Back pain (yes)	−5.32	0.004	−4.94	0.03	−7.23	0.001	−7.38	0.01	−16.01	0.003	−13.19	< 0.001	−3.28	0.13	−0.81	0.53
Model R^2	50.34%		58.58%		34.89%		33.24%		31.64%		39.05%		18.54%		52.66%	

* Models obtained taking as reference men younger than 70 years without previous hip disorders, comorbidities, and back pain; β_i = estimated β coefficient; MCSS = SF-36 mental component summary scale; NA = not applicable; OA = osteoarthritis.

Our study had several limitations. First is the percentage of nonresponders or missing values. However, we had what we considered a good response rate before the intervention and at 6 months (75%). This is comparable to those in other large followup studies [5, 19]. When comparing patients who responded with those who did not, we found no differences in the most relevant variables. Therefore, although a bias may be present in our study owing to these losses, we believe it is likely to be minor and our results can be generalized to the entire sample. Second, we present results of followup up to 6 months and, with a subsample, up to 2 years after the intervention, as previous researchers also have done. According to our results and those of others [15, 36], the changes in HRQoL produced between 6 months and 2 years after the intervention are small, therefore 6 months seems an appropriate timing for evaluation [9]. Nevertheless, we studied the predictive value of the same variables at 2 years. Most remained predictors, although some of them (age, with WOMAC; education, gender, presence of OA in the contralateral hip, and social support with the SF-36) no longer predicted changes. This difference could be attributable to the fact that those variables were not really predictive or the smaller sample size we have at 2 years. Third, although the questionnaires that measure HRQoL provide valuable information, they also have some inherent problems. Cited limitations of the two HRQoL tools used in this study include the presence of a ceiling effect after THA and the poor ability of the SF-36 to predict postoperative improvement on an individual basis, which should prevent it being used as a stand-alone tool to determine treatment selection [30, 36]. However, the two HRQoL tools have been recommended by others for this kind of study [34, 38].

Several studies have included some of the variables examined in this work, but as far as we know, no study included as comprehensive a range of variables in relation to the SF-36 and WOMAC. Our study confirms the findings of others [7, 14, 24] that the worse the preintervention health status, the higher was the gain expected after the intervention. Nevertheless, the patients with low preintervention scores, although gaining relatively more, did not reach the scores of the patients with higher preintervention scores, at least not in certain domains.

Our data also confirm the finding of one study [4] showing the worse the preintervention mental health status, the worse the outcomes. Some studies of TKA also have suggested the preintervention mental health score of the SF-36 independently predicted the postintervention changes in all the domains of the SF-36 and WOMAC [11, 25]. This was the only variable we found that predicted HRQoL changes in all domains of both questionnaires.

Various studies have evaluated separately the influence of different patient characteristics on THA results (Table 6). The influence of age [6, 21, 29, 32, 35, 37], gender [22, 24], and other sociodemographic variables [26] have been studied. In most of the previously mentioned studies, age had no influence on the changes experienced after the intervention. However, differences were found regarding male gender; few other sociodemographic variables were identified as predictors apart from race or occasionally education status. Owing to the homogeneous population in our region, race does not predict outcome

Table 6. Results of selected studies* regarding influence of different patient characteristics on changes after THA

Patient characteristic evaluated	Studies	Results in outcomes (mean changes) after THA			Results in our study
		Gain	Loss	No influence	
Older age	Nilsdotter and Lohmander [32]		X		Loss (in some domains)
	Rissanen et al. [37]			X	
Gender (female)	Kennedy et al. [24]			X	Loss (in some domains)
Social support (yes)	Ethgen et al. [13]	X			No influence
Obesity	Stickles et al. [40]			X	No influence
	Moran et al. [31]			X	
Comorbidities	Bischoff-Ferrari et al. [4]				Loss (in some domains)
Back pain	Wolfe [44]		X		Loss (in some domains)
Contralateral hip OA	Nilsdotter et al. [33]		X		Loss (in some domains)
Longer time on waiting list	Nilsdotter and Lohmander [32]			X	No influence
	Hajat et al. [17]		X		
	Davis et al. [9]			X	
Higher patient expectations	Mahomed et al. [27]	X			No influence
Worse mental health status	Bischoff-Ferrari et al. [4]		X		Loss (in all domains)

* Studies were selected by having design and outcomes selected similar to our study; OA = osteoarthritis.

[37]. The influence of the presence of obesity [20, 31, 40] and diverse comorbidities [4, 16, 44], including the influence of the Charlson Comorbidity Index [18], also has been studied. As we found, previous studies have reported obesity did not predict postoperative changes, whereas the Charlson Comorbidity Index did in some domains. Other studies suggest using other comorbidity indices not predictive of mortality, like the Charlson Comorbidity Index, but morbidity may predict changes [16]. In our study, back pain was predictive for some domains. The influence of patients' expectations [27], the presence of social support [13], the time the patient remains with symptoms [41], and the waiting time until the intervention [9, 17, 23, 28] all have been evaluated. The results of previous studies have differed regarding the influence of these factors, especially in relation to the waiting time until the intervention. We found the time the patient was symptomatic or the waiting time until surgery did not predict changes in any WOMAC domain, nor did patients' expectations or the presence of social support. However, some other physiologic, local mechanical, and neuromuscular factors not included in this work have predicted changes experienced after TKA [39]. Therefore, future studies also should concentrate in the predictive capacity of changes in those variables after THA.

Our study, like some others, showed age, obesity, time on the waiting list, and patient expectations do not have an influence on changes in HRQoL parameters after THA. In general, after a THA, an important gain in HRQoL can be expected. However, female gender, the presence of comorbidities, back pain, contralateral hip OA, or worse mental health status predicted less gain. Nevertheless, the main predictor of change is the preintervention status in each HRQoL of the patient. The SF-36 and WOMAC are appropriate tools to measure the preintervention health status of these patients providing complementary information, although they are difficult to use in clinical practice. Alternatively, patient reports on physical and mental symptoms can provide such information to clinicians. Patients and physicians should consider these findings when discussing the timing and appropriateness of THA.

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References

1. Alonso J, Prieto L, Anto JM. [The Spanish version of the SF-36 Health Survey (the SF-36 health questionnaire): an instrument for measuring clinical results] [in Spanish]. *Med Clin (Barc).* 1995; 104:771–776.
2. Angst F, Aeschlimann A, Steiner W, Stucki G. Responsiveness of the WOMAC osteoarthritis index as compared with the SF-36 in patients with osteoarthritis of the legs undergoing a comprehensive rehabilitation intervention. *Ann Rheum Dis.* 2001;60:834–840.
3. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol.* 1988;15:1833–1840.
4. Bischoff-Ferrari HA, Lingard EA, Losina E, Baron JA, Roos EM, Phillips CB, Mahomed NN, Barrett J, Katz JN. Psychosocial and geriatric correlates of functional status after total hip replacement. *Arthritis Rheum.* 2004;51:829–835.
5. Bombardier C, Melfi CA, Paul J, Green R, Hawker G, Wright J, Coyte P. Comparison of a generic and a disease-specific measure of pain and physical function after knee replacement surgery. *Med Care.* 1995;33(suppl):AS131–AS144.
6. Brander VA, Malhotra S, Jet J, Heinemann AW, Stulberg SD. Outcome of hip and knee arthroplasty in persons aged 80 years and older. *Clin Orthop Relat Res.* 1997;345:67–78.
7. Caracciolo B, Giaquinto S. Determinants of the subjective functional outcome of total joint arthroplasty. *Arch Gerontol Geriatr.* 2005;41:169–176.
8. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis.* 1987;40: 373–383.
9. Davis AM, Agnidis Z, Badley E, Kiss A, Waddell JP, Gross AE. Predictors of functional outcome two years following revision hip arthroplasty. *J Bone Joint Surg Am.* 2006;88:685–691.
10. Escobar A, Quintana JM, Bilbao A, Azkarate J, Guenaga JI. Validation of the Spanish version of the WOMAC questionnaire for patients with hip or knee osteoarthritis: Western Ontario and McMaster Universities Osteoarthritis Index. *Clin Rheumatol.* 2002;21:466–471.
11. Escobar A, Quintana JM, Bilbao A, Azkarate J, Guenaga JI, Arenaza JC, Gutierrez LF. Effect of patient characteristics on reported outcomes after total knee replacement. *Rheumatology (Oxford).* 2007;46:112–119.
12. Ethgen O, Bruyere O, Richy F, Dardennes C, Reginster JY. Health-related quality of life in total hip and total knee arthroplasty: a qualitative and systematic review of the literature. *J Bone Joint Surg Am.* 2004;86:963–974.
13. Ethgen O, Vanparijs P, Delhalle S, Rosant S, Bruyère O, Reginster JY. Social support and health-related quality of life in hip and knee osteoarthritis. *Qual Life Res.* 2004;13:321–330.
14. Fortin PR, Clarke AE, Joseph L, Liang MH, Tanzer M, Ferland D, Phillips C, Partridge AJ, Bélisle P, Fossel AH, Mahomed N, Sledge CB, Katz JN. Outcomes of total hip and knee replacement: preoperative functional status predicts outcomes at six months after surgery. *Arthritis Rheum.* 1999;42:1722–1728.
15. Fortin PR, Penrod JR, Clarke AE, St-Pierre Y, Joseph L, Bélisle P, Liang MH, Ferland D, Phillips CB, Mahomed N, Tanzer M, Sledge C, Fossel AH, Katz JN. Timing of total joint replacement affects clinical outcomes among patients with osteoarthritis of the hip or knee. *Arthritis Rheum.* 2002;46:3327–3330.
16. Greenfield S, Apolone G, McNeil BJ, Cleary PD. The importance of co-existent disease in the occurrence of postoperative complications and one-year recovery in patients undergoing total hip replacement: comorbidity and outcomes after hip replacement. *Med Care.* 1993;31:141–154.
17. Hajat S, Fitzpatrick R, Morris R, Reeves B, Rigge M, Williams O, Murray D, Gregg P. Does waiting for total hip replacement matter? Prospective cohort study. *J Health Serv Res Policy.* 2002;7:19–25.

18. Harse JD, Holman CD. Charlson's Index was a poor predictor of quality of life outcomes in a study of patients following joint replacement surgery. *J Clin Epidemiol.* 2005;58:1142–1149.
19. Hawker G, Melfi C, Paul J, Green R, Bombardier C. Comparison of a generic (SF-36) and a disease specific (WOMAC) (Western Ontario and McMaster Universities Osteoarthritis Index) instrument in the measurement of outcomes after knee replacement surgery. *J Rheumatol.* 1995;22:1193–1196.
20. Jiganti JJ, Goldstein WM, Williams CS. A comparison of the perioperative morbidity in total joint arthroplasty in the obese and nonobese patient. *Clin Orthop Relat Res.* 1993;289:175–179.
21. Jones CA, Voaklander DC, Johnston DW, Suarez-Almazor ME. The effect of age on pain, function, and quality of life after total hip and knee arthroplasty. *Arch Intern Med.* 2001;161:454–460.
22. Katz JN, Wright EA, Guadagnoli E, Liang MH, Karlson EW, Cleary PD. Differences between men and women undergoing major orthopedic surgery for degenerative arthritis. *Arthritis Rheum.* 1994;37:687–694.
23. Kelly KD, Voaklander DC, Johnston DW, Newman SC, Suarez-Almazor ME. Change in pain and function while waiting for major joint arthroplasty. *J Arthroplasty.* 2001;16:351–359.
24. Kennedy DM, Hanna SE, Stratford PW, Wessel J, Gollish JD. Preoperative function and gender predict pattern of functional recovery after hip and knee arthroplasty. *J Arthroplasty.* 2006; 21:559–566.
25. Lingard EA, Katz JN, Wright EA, Sledge CB. Predicting the outcome of total knee arthroplasty. *J Bone Joint Surg Am.* 2004; 86:2179–2186.
26. MacWilliam CH, Yood MU, Verner JJ, McCarthy BD, Ward RE. Patient-related risk factors that predict poor outcome after total hip replacement. *Health Serv Res.* 1996;31:623–638.
27. Mahomed NN, Liang MH, Cook EF, Daltroy LH, Fortin PR, Fossel AH, Katz JN. The importance of patient expectations in predicting functional outcomes after total joint arthroplasty. *J Rheumatol.* 2002;29:1273–1279.
28. Mahon JL, Bourne RB, Rorabeck CH, Feeny DH, Stitt L, Webster-Bogaert S. Health-related quality of life and mobility of patients awaiting elective total hip arthroplasty: a prospective study. *CMAJ.* 2002;167:1115–1121.
29. March LM, Cross MJ, Lapsley H, Brnabic AJ, Tribe KL, Bachmeier CJ, Courtenay BG, Brooks PM. Outcomes after hip or knee replacement surgery for osteoarthritis: a prospective cohort study comparing patients' quality of life before and after surgery with age-related population norms. *Med J Aust.* 1999;171:235–238.
30. McGuigan FX, Hozack WJ, Moriarty L, Eng K, Rothman RH. Predicting quality-of-life outcomes following total joint arthroplasty: limitations of the SF-36 Health Status Questionnaire. *J Arthroplasty.* 1995;10:742–747.
31. Moran M, Walmsley P, Gray A, Brenkel IJ. Does body mass index affect the early outcome of primary total hip arthroplasty? *J Arthroplasty.* 2005;20:866–869.
32. Nilsdotter AK, Lohmander LS. Age and waiting time as predictors of outcome after total hip replacement for osteoarthritis. *Rheumatology (Oxford).* 2002;41:1261–1267.
33. Nilsdotter AK, Petersson IF, Roos EM, Lohmander LS. Predictors of patient relevant outcome after total hip replacement for osteoarthritis: a prospective study. *Ann Rheum Dis.* 2003;62:923–930.
34. Nilsdotter AK, Roos EM, Westerlund JP, Roos HP, Lohmander LS. Comparative responsiveness of measures of pain and function after total hip replacement. *Arthritis Rheum.* 2001;45:258–262.
35. Norman-Taylor FH, Palmer CR, Villar RN. Quality-of-life improvement compared after hip and knee replacement. *J Bone Joint Surg Br.* 1996;78:74–77.
36. Quintana JM, Escobar A, Bilbao A, Arostegui I, Lafuente I, Vidaurreta I. Responsiveness and clinically important differences for the WOMAC and SF-36 after hip joint replacement. *Osteoarthritis Cartilage.* 2005;13:1076–1083.
37. Rissanen P, Aro S, Sintonen H, Slatis P, Paavolainen P. Quality of life and functional ability in hip and knee replacements: a prospective study. *Qual Life Res.* 1996;5:56–64.
38. Salaffi F, Carotti M, Grassi W. Health-related quality of life in patients with hip or knee osteoarthritis: comparison of generic and disease-specific instruments. *Clin Rheumatol.* 2005;24:29–37.
39. Sharma L, Cahue S, Song J, Hayes K, Pai YC, Dunlop D. Physical functioning over three years in knee osteoarthritis: role of psychosocial, local mechanical, and neuromuscular factors. *Arthritis Rheum.* 2003;48:3359–3370.
40. Stickles B, Phillips L, Brox WT, Owens B, Lanzer WL. Defining the relationship between obesity and total joint arthroplasty. *Obes Res.* 2001;9:219–223.
41. Street J, Lenehan B, Flavin R, Beale E, Murray P. Do pain referral patterns determine patient outcome after total hip arthroplasty? *Acta Orthop Belg.* 2005;71:540–547.
42. Towheed TE, Hochberg MC. Health-related quality of life after total hip replacement. *Semin Arthritis Rheum.* 1996;26:483–491.
43. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care.* 1992;30:473–483.
44. Wolfe F. Determinants of WOMAC function, pain and stiffness scores: evidence for the role of low back pain, symptom counts, fatigue and depression in osteoarthritis, rheumatoid arthritis and fibromyalgia. *Rheumatology (Oxford).* 1999;38:355–361.